CLAIMS

SUB A1

~~1. A method of determining information relating to a contact on a contact sensitive device comprising the steps of:~~

~~providing a member capable of supporting bending wave vibration,~~

~~contacting the member at a discrete location to produce a change in bending wave vibration in the member,~~

~~measuring the changed bending wave vibration in the member to determine a measured bending wave signal, and~~

~~processing the measured bending wave signal to calculate information relating to the contact.~~

~~2. A method according to claim 1, further comprising the step of applying a correction to convert the measured bending wave signal to a propagation signal from a non-dispersive wave source.~~

A

SUB A2

~~3. A method according to claim 2, wherein the correction applied is based on a dispersion relation of the material of the member.~~

~~4. A method according to claim 3, wherein the dispersion relation is modelled by using the bending wave equation in combination with known physical parameters of the material of the member.~~

5. A method according to claim 3, wherein the dispersion relation is measured by using a laser vibrometer to create an image of the vibration pattern in the member for a number of

given frequencies to give the dispersion relation in the frequency range of interest.

6. A method according to claim 3, wherein the dispersion relation is measured using a self-measuring scheme which is incorporated into the contact sensitive device.

7. A method according to claim 1, wherein the information relating to the contact comprises the location of the contact.

8. A method according to claim 1, wherein the information relating to the contact comprises the pressure of the contact.

9. A method according to claim 1, wherein the information relating to the contact comprises the size of the contact.

10. A method according to claim 1, wherein movement of the contact on the member generates a continuous signal which is affected by the location, pressure and speed of the contact on the member, and continuous time data from the continuous signal is used to derive additional information relating to the contact.

11. A method according to claim 10, wherein a neural net is used for processing continuous time data.

12. A method according to claim 1, wherein the contact type is selected from the group consisting of touch by a stylus and touch by a finger.

13. A method according to claim 12, wherein the measuring step comprises measuring the frequency content of the measured bending wave signal to determine the contact type.

14. A method according to claim 1, wherein the measuring step comprises measuring the frequency content of the measured bending wave signal to determine the contact type.

15. A method according to claim 1, wherein the member has a complex shape, and the processing step comprises using an adaptive algorithm to derive information relating to the contact from the measuring bending wave signal.

16. A method according to claim 15, wherein the adaptive algorithm is implemented in a neural net.

~~17. A method according to claim 1, wherein the change in the bending wave vibration produced by the contact is the generation of bending wave vibration in the member by the contact.~~

18. A method according to claim 1, wherein the bending wave vibration in the member is caused by background noise.

19. A method according to claim 1, further comprising the step of comparing the measured bending wave signal with a reference signal to identify when contact is made.

20. A method according to claim 1, wherein the measuring step comprises measuring the changed bending wave vibration at an edge of the member.

21. A method according to claim 1, wherein the measuring step comprises measuring the changed bending wave vibration at a position spaced from the edges of the member.

22. A method of determining information relating to a contact on a contact sensitive device comprising the steps of:

Sub B3

providing a member capable of supporting bending wave vibration,

generating bending wave vibration in the member to probe for information relating to a contact,

contacting the member at a discrete location to produce a change in the generated bending wave vibration in the member,

measuring the changed bending wave vibration in the member to determine a measured bending wave signal, and

processing the measured bending wave signal to calculate information relating to the contact.

23. A method according to claim 22, wherein the effect of the contact is reflective, such that at least some of the generated bending wave vibration is reflected by the contact to produce a change in the generated bending wave vibration in the member.

24. A method according to claim 23, wherein the effect of the contact on the generated bending wave vibration is measured using indirect excitation from at least one boundary reflection.

25. A method according to claim 22, wherein the effect of the contact is absorbing, such that at least some of the generated

bending wave vibration is absorbed by the contact to produce a change in the generated bending wave vibration in the member.

26. A method according to claim 25, wherein the effect of the contact on the generated bending wave vibration is measured using indirect excitation from at least one boundary reflection.

27. A method according to claim 22, wherein the generated bending wave vibration is not acoustically obvious.

28. A method according to claim 27, wherein the generated bending wave vibration simulates background noise.

29. A method according to claim 27, wherein the generated bending wave vibration is outside the audible frequency range.

30. A method according to claim 29, wherein the generated bending wave vibration is in the ultrasonic frequency range.

31. A method according to claim 22, wherein the generated bending wave vibration creates an acoustic output in the member, which acts as an acoustic radiator of a loudspeaker.

32. A method according to claim 31, wherein the processing step comprises isolating undesired signals from the changed bending wave vibration produced by the contact.

33. A method according to claim 22, wherein the processing step comprises isolating undesired signals from the changed bending wave vibration produced by the contact.

34. A method according to claim 22, further comprising the step of applying a correction to convert the measured bending

wave signal to a propagation signal from a non-dispersive wave source.

Sub A4

35. A method according to claim 34, wherein the correction applied is based on a dispersion relation of the material of the member.

36. A method according to claim 35, wherein the dispersion relation is modelled by using the bending wave equation in combination with known physical parameters of the material of the member.

37. A method according to claim 35, wherein the dispersion relation is measured by using a laser vibrometer to create an image of the vibration pattern in the member for a number of given frequencies to give the dispersion relation in the frequency range of interest.

38. A method according to claim 35, wherein the dispersion relation is measured using a self-measuring scheme which is incorporated into the contact sensitive device.

39. A method according to claim 22, wherein the information relating to the contact comprises the location of the contact.

40. A method according to claim 22, wherein the information relating to the contact comprises the pressure of the contact.

41. A method according to claim 22, wherein the information relating to the contact comprises the size of the contact.

42. A method according to claim 22, wherein movement of the contact on the member generates a continuous signal which is

affected by the location, pressure and speed of the contact on the member, and continuous time data from the continuous signal is used to derive additional information relating to the contact.

43. A method according to claim 42, wherein a neural net is used for processing continuous time data.

44. A method according to claim 22, wherein the contact type is selected from the group consisting of touch by a stylus and touch by a finger.

45. A method according to claim 44, wherein the measuring step comprises measuring the frequency content of the measured bending wave signal to determine the contact type.

46. A method according to claim 22, wherein the measuring step comprises measuring the frequency content of the measured bending wave signal to determine the contact type.

47. A method according to claim 22, wherein the member has a complex shape, and the processing step comprises using an adaptive algorithm to derive information relating to the contact from the measuring bending wave signal.

48. A method according to claim 47, wherein the adaptive algorithm is implemented in a neural net.

49. A method according to claim 22, further comprising the step of comparing the measured bending wave signal with a reference signal to identify when contact is made.

50. A method according to claim 22, wherein the measuring step comprises measuring the changed bending wave vibration at an edge of the member.

51. A method according to claim 22, wherein the measuring step comprises measuring the changed bending wave vibration at a position spaced from the edges of the member.

~~52. A method of determining information relating to a contact on a contact sensitive device comprising the steps of:~~

~~providing a panel-form member capable of supporting bending wave vibration,~~

~~generating bending wave vibration in the member from one location on the member to probe for information relating to a contact,~~

~~contacting the member at a discrete location to produce a change in the generated bending wave vibration in the member,~~

~~measuring the changed bending wave vibration in the member at two locations on the member to determine a measured bending wave signal, and~~

~~processing the measured bending wave signal to calculate information relating to the contact.~~

53. A method according to claim 52, wherein the information relating to the contact comprises the location of the contact.

54. A method according to claim 52, wherein the information relating to the contact comprises the pressure of the contact.

55. A method according to claim 52, wherein the information relating to the contact comprises the size of the contact.

56. A method according to claim 52, wherein movement of the contact on the member generates a continuous signal which is affected by the location, pressure and speed of the contact on the member, and continuous time data from the continuous signal is used to derive additional information relating to the contact.

57. A method according to claim 56, wherein a neural net is used for processing continuous time data.

58. A method according to claim 52, wherein the contact type is selected from the group consisting of touch by a stylus and touch by a finger.

59. A method according to claim 58, wherein the measuring step comprises measuring the frequency content of the measured bending wave signal to determine the contact type.

60. A method according to claim 52, further comprising the step of comparing the measured bending wave signal with a reference signal to identify when contact is made.

61. A method according to claim 52, wherein the measuring step comprises measuring the changed bending wave vibration at two edges of the member.

62. A contact sensitive device comprising:

a member capable of supporting bending wave vibration,

at least one sensor coupled to the member for measuring bending wave vibration in the member, and

a processor operatively coupled to the at least one sensor for processing information relating to a contact made on a surface on the member from the change in bending wave vibration in the member produced by the contact and measured by the at least one sensor.

63. A contact sensitive device according to claim 62, wherein the contact sensitive device is a passive device where the change in bending wave vibration in the member caused by the contact is the generation of bending wave vibration in the member by the contact.

64. A contact sensitive device according claim 63, wherein the member is a display screen.

65. A contact sensitive device according to claim 64, wherein the display screen is a liquid crystal display screen, and the at least one sensor comprises liquid crystals of the display screen which sense bending wave vibration in the member.

66. A contact sensitive device according to claim 62, wherein the at least one sensor is mounted at an edge of the member.

67. A contact sensitive device according to claim 62, wherein the at least one sensor is mounted on the member spaced from an edge of the member.

68. A contact sensitive device according to claim 62, wherein the member is transparent.

69. A contact sensitive device according to claim 62, wherein the member is in the form of a panel.

70. A contact sensitive device according to claim 62, wherein the member has uniform thickness.

~~71. A contact sensitive device according to claim 62, wherein the member has a complex shape.~~

72. A mobile phone comprising a contact sensitive device according to claim 62.

73. A lap-top computer comprising a contact sensitive device according to claim 62.

74. A personal data assistant comprising a contact sensitive device according to claim 62.

~~75. A contact sensitive device according to claim 62, further comprising an emitting transducer coupled to the member for exciting bending wave vibration in the member to probe for information relating to the contact.~~

~~76. A contact sensitive device according to claim 75, wherein information relating to the contact is calculated by comparing the response of bending wave vibration generated by the emitting transducer to a mechanical constraint caused by the contact.~~

77. A contact sensitive device according to claim 75, wherein the emitting transducer has dual functionality and acts as the emitting transducer and the at least one sensor.

Sub A8

78. A contact sensitive device according to claim 75, wherein the emitting transducer and the at least one sensor are placed with a relatively equal spacing around the periphery of the member.

79. A contact sensitive device according to claim 75, wherein the emitting transducer and the at least one sensor are located at the same point and are coupled into orthogonal physical properties.

80. A contact sensitive device according to claim 79, wherein the emitting transducer is one of the group consisting of an inertial transducer and a bender transducer, and the at least one sensor is the other of said group.

Sub A9

81. A contact sensitive device according claim 75, wherein the member is a display screen.

82. A contact sensitive device according to claim 81, wherein the display screen is a liquid crystal display screen, and the at least one sensor comprises liquid crystals of the display screen which sense bending wave vibration in the member.

83. A contact sensitive device according to claim 82, wherein the emitting transducer comprises liquid crystals of the display screen which excite bending wave vibration in the member.

Sub A10

84. A contact sensitive device according to claim 75, wherein the at least one sensor is mounted at an edge of the member.

85. A contact sensitive device according to claim 75, wherein the at least one sensor is mounted on the member spaced from an edge of the member.

86. A contact sensitive device according to claim 75, wherein the member is transparent.

87. A contact sensitive device according to claim 75, wherein the member is in the form of a panel.

88. A contact sensitive device according to claim 75, wherein the member has uniform thickness.

89. A contact sensitive device according to claim 75, wherein the member has a complex shape.

Sub A11

90. A mobile phone comprising a contact sensitive device according to claim 75.

91. A lap-top computer comprising a contact sensitive device according to claim 75.

92. A personal data assistant comprising a contact sensitive device according to claim 75.

93. A contact sensitive device incorporating a loudspeaker, the device comprising:

a member capable of supporting bending wave vibration and forming an acoustic radiator when excited,

an exciter coupled to the member for exciting bending wave vibration in the member to probe for information relating

to a contact made on a surface of the member, and to cause the member to produce an acoustic output,

at least one sensor coupled to the member for measuring bending wave vibration in the member, and

SUB A17

a processor operatively coupled to the at least one sensor for processing information relating to the contact from the change in bending wave vibration in the member produced by the contact and measured by the at least one sensor.

94. A contact sensitive device according to claim 93, wherein the member is in the form of a panel.

95. A contact sensitive device according to claim 94, wherein the member has uniform thickness.

96. A contact sensitive device according to claim 95, wherein the at least one sensor is mounted at an edge of the member.

97. A contact sensitive device according to claim 95, wherein the at least one sensor is mounted on the member spaced from an edge of the member.

ADD A127